ENVIRONMENTAL AND EVOLUTIONARY ECONOMIC GEOGRAPHY: TIME FOR EEG2?

by

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ABSTRACT. This article argues that recent proposals for environmental and evolutionary economic geographies (EEG1 and EEG2) should be integrated; EEG2 is used as “passing convenience” to make this case. EEG1’s emphasis on environmental imperatives is loosely framed and needs a theoretical socio-economic evolutionary base that is the central thrust of EEG2. Meanwhile EEG2 would be empowered by incorporating environmental concerns within its mandate. Moreover, both EEG1 and EEG2 share common roots in institutional methodologies, emphasize cumulative causation and path-dependent behaviour, have strong interests at regional scales of analysis, and both are intimately tied to the causes and consequences of innovation. This article provides a rationale and suggests an integrative conceptual approach for developing EEG2. In particular, the article outlines a conceptual framework that interprets EEG2 in terms of co-evolutionary socio-ecological and multi-scalar processes that are situated within a reasoned history interpretation of economic development. This framework further highlights the roles of path dependency, innovation, multinational corporations and value chains. How this multi-scalar framework may be elaborated is then discussed around three themes: extending placed-based analysis of localized clusters; broadening the scope of global value chain analysis; and re-engaging the analysis of core-periphery relations. Ultimately the case for EEG2 is to ensure that economic geographic perspectives are fully incorporated in debates over the co-evolution of economy and environment, in research and policy terms one of, if not the, central challenges of development in the 21st century.

Keywords: EEG1, EEG2, innovation, multi-scalar framework, path dependency

Introduction

In recent years, growing pleas for an environmental economic geography (Gibbs 2006; Hayter 2008; Soyez and Schulz 2008; see also Hudson 2007; Heidkamp 2008) have been paralleled, perhaps overshadowed by the promotion of an evolutionary economic geography, recently highlighted by a large, edited handbook that articulates its spirit and purpose (Boschma and Martin 2010a). For the most part, these literatures are evolving in distinct ways, as EEG1 and EEG2 as it were. If such separate trajectories are consistent with economic geography’s fragmented intellectual history they unfortunately implicitly reinforce strong tendencies to either focus on environmental or economic matters, but not both. More generally, the creation of EEG1 and EEG2 as separate solitudes undermines economic geography’s integrative role and collective abilities to contribute to broader policy debates. This article is a plea to integrate EEG1 and 2, in effect for an EEG2.

In a sympathetic critique, Bridge (2008a, p. 76) characterized EEG1 ‘as a loose assemblage of ideas’ while recognizing its key mandate to encourage economic geography, regardless of guise or label, to take the environment seriously. Potentially, EEG2’s interpretations of geographically differentiated, integrated development that are rooted in core evolutionary principles offer frameworks and ideas to connect these ideas more coherently. Yet, EEG2, and the closely related emerging focus on resilient regions, has largely ignored the environment both with respect to its earliest propositions (Boschma and Frenken 2003, 2006; Hassink 2005; Martin and Sunley 2006) and more recent conceptualizations of the field (Boschma and Martin 2010a). This neglect is surprising. After all, stimulated by the Brundtland report (WCED 1987), debates over global (and local) futures have highlighted the triple challenge of economy, environment, and equity (Elkington 1998). Indeed, incorporating the environment, and recognizing economic geography’s growing interests in this regard (e.g. Florida 1996; Gibbs 2000; Schulz 2002; Hudson 2010), could be as important a contribution to understanding economic development as EEG2’s claim to compensate for neoclassical economics’ focus on equilibrium states and failure to deal with institutional change (Boschma and Martin 2010a). Moreover, even if the practices of EEG1 and 2 are locked into particular literatures, research questions and range of variables deemed important (Soyez 2002), their integration as EEG2 does not pose ideological challenges or profound conceptual leaps, or require claiming

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another “turn” for economic geography (Grabher 2009). Thus contemporary enthusiasm for EEG2 was stimulated by debates regarding methodological and/or metaphorical connections with biology, the core environmental science (Essletzbichler and Rigby 2007; MacKinnon et al. 2007), and Hodgson and Knudsen’s (2010) ambitious proposal for Generalized Darwinism or Darwinian Co-evolution as a meta-theory for studies of evolution from multiple disciplinary perspectives. Indeed, EEG2 is intimately connected to radical institutional economics and a mirror of Véblen’s plea for economics to be evolutionary science (Kapp 1976; Essletzbichler and Rigby 2007; Rafiqui 2009). Similarly, EEG1 has been conceptualized in institutional Qua evolutionary terms (Hayter 2008), and by the related literatures of regulation theory (Angel 2000), ecological modernization (Gibbs 2000, 2006) and industrial ecology (Lyons 2007). Regardless of whether Generalized Darwinism is possible, EEG2 can draw upon a common methodology and range of “middle range” or “auxiliary concepts” (Hodgson and Knudsen 2010, p. 234), beginning with the closely related principles of circular and cumulative causation (Myrdal 1957) and path dependency (Martin 2010).

This article’s plea to integrate EEG1 and 2 focuses on a conceptual framework that links and elaborates multi-scalar and co-evolutionary perspectives. Economic geography has long been sensitive to the implications of geographic scale for understanding decision-making and/or environmental processes, and appreciative of ecological fallacies and related problems in transposing explanations across scales. Yet, it is reasonable to suggest that EEG1 and (especially?) 2 have been preoccupied with local and regional scales (Essletzbichler and Rigby 2010; Martin and Sunley 2010; Schamp 2010). Explicit grappling with multi-scalar frameworks, such as those proposed by Schultz and Soyez (2006), Andonova and Mitchell (2010) and Reed and Bruyneel (2010), that incorporate environmental and socio-economic processes that feature scale-jumping, non-hierarchical interdependencies and overlapping but different geographies, remains embryonic. In this regard, the nature and extent to which environmental and socio-economic processes are co-evolutionary, that is mutually causative, is a significant challenge facing EEG2. However, co-evolution has emerged as an important theme in ecological economics (Norgaard 1994; Kallis and Norgaard 2010; Foxon 2011), and in the complementary “reasoned history” approach of institutional or evolutionary economics that seeks to explain patterns of economic development over the last 250 years (Freeman and Louça 2001). Indeed, these co-evolutionary perspectives can contribute to, and be enriched by, the incorporation of a multi-scalar dimension. As Kallis and Norgaard (2010) note, citing Boschma and Martin (2007), the understanding of co-evolution in ecological economies needs to pay more attention to space (see Foxon 2011). After all, environmental problems are not only global but site specific and prevalent in all in-between scales (O’Riordan 2002). In general, a multi-scalar EEG2 may be regarded as advocacy for the insertion of “reasoned geography” in co-evolutionary thinking.

The remainder of the article is in three main parts. The first two parts respectively define and relate the themes of co-evolution and multi-scalar perspectives in a framework that ultimately addresses the economic geography of proposals for a Green Paradigm or Sustainability Transition (Freeman 1992; Coenen et al. 2012). Third, the article suggests ways that economic geography might explore co-evolutionary multi-scalar approaches, initially by extending present emphases on local/regional analyses and then more especially by incorporating the dynamics of multinational corporations (MNCs) and value chains, neither of which features prominently in EEG1 and 2. We further extend the latter discussion to embrace core–periphery relationships. We would emphasize the heuristic nature of this discussion and that references to EEG1 and 2 and EEG2 are simplifications and “passing conveniences” in which the main goal, regardless of labels, is to help encourage a multi-scalar co-evolutionary perspective that examines systemic relationships between social and environmental systems in which economic geography fully participates. Norgaard and Kallis (2011) make a similar plea for geography’s engagement in more systematic applications of co-evolutionary thinking.

Co-evolving towards a multi-scalar approach

Evolution and co-evolution are not straightforward to define. Indeed, Hodgson (2010, p. 710) prefers a highly generalized, even vague starting point, suggesting that ‘it is best to use the term evolution broadly to refer to significant change’ that in Hodgson’s institutional terms may be summarized as changes, sudden or gradual, formal or informal, in routines, customs and attitudes. From a
more Darwinian starting point, Kallis and Norgaard (2010, p. 690) define evolution for “complex populations” as ‘a process of selective retention of renewable variation’ and that ‘evolutionary analysis explains how variety is generated (renewed) in the population, how advantageous properties are retained and passed on and why entities differ in their propagation’. This statement can readily be modified to address negative or viscous change in which “disadvantageous properties” are “retained and passed on” over time. Whether virtuous or vicious, in both EEG 2 and 1, path-dependent socio-economic and/or environmental processes, in a way that resonates closely with Myrdal’s (1957) earlier concept of cumulative causation, are deeply engrained, sequential, cumulative and multi-faceted, not reducible to silver bullet explanations or solutions. Thus EEG2 has especially focused on the path-dependent behaviour of firms, industries and clusters that grow and diversify or have become locked-in to obsolete institutional and technological practices that undermine competitiveness and seek rejuvenation (Martin 2010). Similarly, path-dependent commitments and sunk costs in inappropriate technologies, business practices, policies and consumption habits underlay the environmental problems that are central concerns of EEG1.

Recent literature on co-evolution in ecological and institutional economics has sharpened the debate over how path-dependent processes, including those linking society and environment, can be analyzed. Thus according to Kallis and Norgaard (2010, p. 695), ‘Co-evolution is the evolution of variation between populations that are systematically related’. That is, co-evolution implies causal relationships between population characteristics or systems, not mere associations, as they change over time. Within (or across) such broad categories, as Kapp (1976, p. 221) noted, the boundaries of co-evolutionary analysis in terms of what processes or factors should be incorporated is judgmental and should be defined by what is relevant. While examination of co-evolution can simply focus on dyadic relations, such as those between predator and prey, Foxon (2011) suggests that more generally co-evolutionary interactions can be classified into as biological, social, gene-culture, bio-social and socio-ecological evolutionary systems. Within the context of socio-ecological evolution, in order to direct analysis and policy prescriptions towards a contemporary green paradigm or the sustainability transition, Foxon (2011) further identifies a five-fold framework of co-evolutionary sub-systems that highlight the interdependent roles of ecosystems, institutions, user practices, business strategies and technologies. As Foxon recognizes, this proposed greening of the economy involves paradigmatic change that is consistent with Freeman and Louça’s (2001) Schumpeterian-inspired (creative destruction) ‘reasoned [economic] history’ model of economic development in which long waves or economic transformations, summarized as techno-economic paradigms (TEPs), are driven by the interacting co-evolutionary sub-systems of technologies, science, economics, politics, and cultures. Admittedly, neither the socio-ecological and reasoned history models of co-evolution highlight geographic perspectives. However, both models are sensitive to geographic variation and can enrich, and be enriched by, multi-scalar interactions and differences (Fig. 1). This framework is now explicated.

Freeman and Louça’s (2001) reasoned history approach explains the breadth and depth of the paradigm shifts that have accompanied global economic development since 1760 and readily incorporates changing environment–economy relations, and how they may change in the future (Hayter 2008). This model thus provides context vital to understanding contemporary socio-ecological change and a meta socio-technological rationale for an EEG2. In general, technological and institutional innovation is the key to the creative destruction of capitalist economies that disrupts existing, and initiates new forms of path dependencies and cumulative causation, opens up new economic spaces and threatens old ones, and widens inequality gaps between innovative and non-innovative countries (Freeman and Perez 1988; Freeman 2008). Moreover, innovation is interpreted broadly as a result of social processes driven by the quasi-independent but reciprocal “histories” (processes) of science, technology, politics, culture and economics, none of which has explanatory priority. This reasoning rejects technological determinism or predicting futures by simple extrapolation but rather emphasizes the complex and uncertain co-evolution or “matching” of technological and institutional innovations that range from the incremental to the paradigmatic. Long-run patterns of economic development are summarized as TEPs or long waves that indicate fundamental restructuring (paradigm changes) in capitalist economies in which the nature, organization, productivity principles and location of activities experience secular change. Five TEPs are recognized, the last two being the Fordist TEP (circa 1920 to 1970s) and the
information and communication TEP (ICT). The model is geographical in the sense of its recognition of “lead nations”, which are countries that best match institutions with technology imperatives to facilitate economic growth, and differences in national innovation systems, along with their regional counterparts (Freeman 2008).

Moreover, the long waves of economic development pulsate with environmental impacts and consequences (Freeman 1992). From this perspective, Allenby’s (1999) idea of “environmental phases”, that refer to public and private sector attitudes, values and policies towards the environment, have co-evolved with industrialization and readily connect to TEPs (Hayter 2008). Briefly, 18th and 19th century industrialization largely considered
nature to be a sink in which pollutants were “externalized” without direct cost or concern for ecological and social impacts. Meanwhile pioneering responses to preserve environmental values, such as the creation of Yellowstone National Park, or to offset socially deplorable living conditions, such as Saltaire and other privately built communities, were ad hoc and limited. During Fordism, environmental awareness became more substantial, even systemic in local and regional plans reflected in the garden city movement, low-density housing for working people, incorporation of parks and green spaces, the development of conservation areas, and the recognition of amenities as location factors. Simultaneously, however, the mass production and consumption imperatives of Fordism, based on the pervasive use of “cheap” oil, stimulated the globalization of environmental problems and warnings of global ecological disaster (Carson 1962; Meadows et al. 1972). Freeman (1992), following Cole et al. (1973), agreed that environmental problems had become a central challenge to long-term development. Yet he was more sanguine about Meadows et al.’s (Club of Rome) simulated warnings of ecological collapse that were predicated on linear extrapolations of growth rates and resource use and ignored possibilities that (institutional and technological) innovations change socio-ecological relationships. Indeed, he noted that since the 1960s environmental regulations at local, national and international scales, and the technics of the ICT, had begun to stimulate greening trends in modern economies, including by more efficient use of materials and resources. But these technics primarily sought to improve economic efficiency through various forms of flexible production and Freeman argued the need to redirect innovation priorities towards ensuring the evolution of a Green TEP that prioritized both environment and poverty reduction. Within economic geography recent pleas for a sustainability transition make the same point (Coenen et al. 2012).

Indeed, reasoned history readily appreciates that the natural environment has ‘its own history’ that is ‘reciprocally influenced by industrialization and economic growth’ and that ‘ecological factors may predominate in determining the rate and direction of economic growth during the twenty-first century’ (Freeman and Louça 2001, p. 126). In an empathetic elaboration of this view the framework of socio-ecological co-evolution developed by Kallis and Norgaard (2010) and Foxon (2011) highlights the quasi-autonomous, reciprocating influences of ecosystems, institutions, user practices, business strategies and technologies (Fig. 1). Indeed, this framework is designed to facilitate empirical and policy assessments of paradigmatic shifts to low-carbon economies and provides a co-evolutionary way of thinking that is sympathetic to but distinct from the sustainable transition model that has also been developed recently (Geels 2002). In brief, the transition model distinguishes between meso-, macro- and micro-scale levels. These levels are respectively defined by “landscapes” that refer to deeply embedded social and political values and attitudes that are slow to change; “socio-technical regimes” that are prevailing routines and practices; and “technological niches” that provide spaces for radical innovations and new networks. In this model, the significance attached to transition pathways, which result from the interaction of social and technical factors in each of these levels, and to institutional factors overlaps with the socio-ecological framework (and reasoned history). According to Foxon (2011, pp. 2259–2260), however, the sustainable transition model is more about “alignment” than evolution, tends to overemphasize the influence of sociological structures and pays insufficient attention to choice processes especially by business, governments and other economic agents.

In general, the socio-ecological framework complements reasoned history by its more explicit incorporation of ecological considerations and the sustainability transition approach by paying more attention to business strategies, technologies and institutions and to evolutionary concepts such as adaptation, retention, hybridization and resilience. Indeed, this framework has many points of contact with EEG1 and 2, not least with respect to basic definitions of technology, institutions, business strategies and user practices. Moreover, it emphasizes the fundamental uncertainty of co-evolutionary processes, their path-dependent nature, their sensitivity to crises and events in general, the importance of innovation, and the need for multi-factor explanations and policy responses. Further, this approach has especially stressed the challenges of developing a diversity of low-carbon futures, a challenge that is being addressed in economic geography (Bridge et al. 2013; Essletzbichler 2012). In this regard, Foxon (2011, p. 2265) recognizes, without elaborating, that the socio-ecological framework is flexible in its application to local, regional, national or global scales. Indeed, the incorporation of a multi-scalar perspective is vital to the understanding
of co-evolutionary socio-economic processes. Moreover, it is important not to simply associate geographic scales with a set of containers or as corresponding exactly to landscapes, regimes and niches. Rather, whether classified at local, regional, national or global scales, regions can themselves be recognized as institutions that are quasi-independent and influence one another. The independence is manifested by the scope and mandate of key decision-making institutions and political definitions of territory while connections across scales occur as value chains and cycles (Fig. 1). Indeed, the elaboration of co-evolutionary approaches faces significant challenges. Thus environmental and social processes exhibit different time as well as spatial scales, impacts can be asymmetric, specifying what is evolving with what is not straightforward, evolutionary changes may be hard to discern from other kinds of change, and inter-disciplinary understanding is required (Norgaard and Kallis 2011). Yet public policy demands these challenges be met and Norgaard and Kallis (2011, pp. 296–298) have sketched three approaches that have potential for the co-evolutionary analyses of environmental and social systems while recognizing geography’s integrative credentials in this regard. A useful starting point for economic geography is the relationships between governance and economic development.

A multi-scalar environmental framework: governance and economic development

A multi-scalar approach to dealing with environmental issues is intuitive: we are aware of environmental problems that can be differentiated by local and global impacts; that MNCs and Greenpeace confront each other among the world’s places and spaces; that UN attempts to govern the climate; or that municipal authorities, with local non-governmental organizations (NGOs) as critics, attempt to encourage consumers and businesses to recycle. Yet the multi-scalar approach to environmental governance is complex and surprisingly new in manifesting itself and to scholarship. Within geography and the social sciences generally, this emerging interest springs from the need to re-scale environmental governance away from a preoccupation with the state to other levels of responsibility, influence and power and to incorporate other participants, including the entry of new actors and institutions, in the shaping of values, policies and behaviours (Bridge and Perreault 2009; Reed and Bruyneel 2010). Broadening the definition of governance to include a wide diversity of actors interacting within distinct places or across space was necessitated by the realities of dealing with the complexity and interdependence of social and economic influences on the environment.

To the extent that environmental geography has adopted a multi-scalar governance framework it has aligned itself with the study of environmental politics. Not only does environmental politics share a geographical framework for the investigation of vertical relations between scales and horizontal relations among regions and sectors within scales (Andonova and Mitchell 2010), but environmental geography (including EEG1) has come to share a focus on governance, power and politics. Environmental governance manifests itself and is imposed among different places and spaces along many dimensions, each with particular mechanisms of organization: the commodity chain and MNC networks with their transaction cost-based relationships; territories contested through the politics of property regimes and resource exploitation; the expansion of political participation and stakeholder involvement; development and influence of epistemic communities; devolution of environmental regulatory power, trans-boundary or multi-jurisdictional conservation management, among others (Schulz et al. 2006; Andonova and Mitchell 2010; Reed and Bruyneel 2010). The Schulz et al. (2006) framework, for example, begins with interdependency between market, society and politics and then sketches out relationships within and between global, transnational, national and subnational spaces. At each spatial level, forms of economic organization (e.g. in descending order, WTO, NAFTA, industrial organization, and companies) are governed by political-regulatory bodies and social entities such as environmental non-governmental organizations (ENGOs). The spatial levels are connected by vertical relationships among market, political and social entities (e.g. firm hierarchies, national governance structures and between local, national and global NGOs) and transverse relationships across space (e.g. connections among local NGOs, links among affiliated, dispersed branch plants or extended firm-supplier relations, inter-regional cooperation).

Much important geography research is empirically substantiating this framework. Studies that have focused on local or regional levels while still incorporating global interdependencies into their explanations include Adger et al.’s (2009) discussion of nested and tele-connected vulnerabilities,
Affolderbach’s (2011) investigation of the interrelations between local populations, MNCs and ENGOs in Tasmania and British Columbia, and Agrawal’s (2005) conceptualization of how the devolution of scientific forest management resulted in the creation of environmental subjects. At the horizontal level, Bulkeley’s (2005, 2010) work on networks such as C40 or ICLEI (International Council for Local Environmental Initiatives) illustrates the cross-fertilization of best practices across space among different local jurisdictions. Jones (forthcoming) also looked at (horizontal) urban governance linkages while finding (vertical) climate policy coordination between cities and federal government to be lacking. Meanwhile the environmental performance of MNCs that generate vertical and horizontal relations around the globe are partially disciplined by the proliferation of global environmental standards and environmental management providers (Schulz 2005; Angel et al. 2007). Other studies have examined natural resource-based commodity chains, and the governance afforded by certification and labeling schemes (Stringer 2006) or alternatives such as Fair Trade schemes (Taylor 2005) and local food networks (Renting et al. 2003). The environmental impacts incurred in peripheral production sites as part of the production for and environmental expectations of urban markets have also been discussed (Hayter and Soyez 1986; Soyez 2002). Environmental geography, inclusive of EEG1, thus has made a strong case for environmental governance that integrates disciplines and modifies economic practices across scales. Simultaneously, these trends are changing the social, political and regulatory context in which businesses operate. By implication, although not well articulated, the processes generating these new forms of multi-scalar governance are co-evolving among interacting sub-systems of technologies, science, economics, politics, and cultures (Freeman and Louça 2001; Foxon 2011). Environmental governance, however, does not explicate the process of development – why and how firms work together, why they innovate and diversify and expand production, how firm or regional competitive advantages are generated, why restructuring occurs and so on. Environmental governance also does not explain why development does not occur (although it is too often assumed ex ante that it will hinder development). We believe that perspective is needed and indeed crucial to understanding the changes that must occur across economies of all scales and sectors. EEG2 brings several useful tools to this endeavour. In general, the multi-scalar approach that it engenders, with its basis in governance, reflects economic geography’s need to explain change over time in institutional and political economy terms (Hayter 2004; MacKinnon et al. 2009). This imperative now requires the impediments and means to facilitate transitions to environmentally as well as economically sustainable development to be unravelled.

EEG2 provides several concepts and analytical tools beneficial to the sustainability challenge. Foremost, the yin and yang of path dependency – lock-in versus innovation – theory provides a foundation on which to analyze the intransigence of existing and environmentally unsound industrial practices, while simultaneously opening up the possibilities for qualitative change. That possibility is recognized within EEG2 by the distinction as to whether firm routines are generated by place-based institutions or deriving from general and exogenous origins are then influenced by place-based institutions to take on a particular nature. Boschma and Frenken (2006) argue for place-based influences to allow more scope for innovations in firm behaviour, policy and for positive circular causation to take hold, rather than firms remaining in a vicious cycle of environmental misbehaviour.

The likelihood of changes in firm routines occurring is fleshed out by emphasizing the roles of competition (Essletzbichler and Rigby 2010) and entrepreneurship (Stam 2010) while using concepts such as related and non-related variety. Further the relational bases of EEG2 explanations are transmitted by models that identify and measure knowledge spillovers and transfers within networks and clusters. Indeed EEG2’s contributions to EEG2 largely originate in regional and national innovation systems (Cooke and de Laurentis 2010) and/or follow traditions of institutional analyses of social capital and political economy that are drawn from Granovetter or North (Malmberg and Maskell 2010). Despite criticisms to the contrary (MacKinnon et al. 2009), EEG2 has also paid attention to political economy and institutions, especially in those studies that have explicitly addressed co-evolution by triangulating the influences of different economic, social, political institutions and technology with each other (Schamp 2010; Strambach 2010).

The regional focus within EEG2 provides a platform to examine path dependency and lock-in (Martin and Sunley 2010) and a venue to supply cluster and network analysis (Giuliani 2010;
EEG2: co-evolution across geographical scales

Thus far we have argued that EEG2 requires not only a co-evolutionary perspective, that of causal interdependent change among economic, social, political, technological and environmental forces over time, but also that the systemic nature of that change compels investigations of interdependencies across geographical scales. Recent research on multi-scalar governance provides a framework to begin that investigation, but further elaboration of where and why bottlenecks or seedbeds of sustainability may occur within global multi-scalarity needs to draw on concepts such as path dependence and regional innovation systems. Moreover, in addition to highlighting the environmental governance of economic relationships, conceptual constructs that feature economic transactions and development need to be incorporated. We propose MNCs and GVCs/GPNs as two of those central constructs. To illustrate, this final section first examines how EEG2 can be extended from a place-based focus; that is, we review a few papers offering what we consider instructive EEG2 analyses that are focused at local or regional levels with the intention of examining the impacts of global governance and competition. Second, we sketch out and exemplify how a GVC/GPN framework could incorporate environmental performance into global production, consumption and recycling systems, a discussion that is extended in the third part to incorporate core–periphery relations. By way of context, how co-evolution (inclusive of EEG2) and multi-scalarity (based on the EEG1 governance framework) inform each other, and offer potential for further research, has been summarized (Table 1).

Extending place-based EEG2

Orienting economic geography from a place perspective is reflexive, accounting for much of new industrial district, cluster and regional innovation system approaches to finding ‘sticky places in slippery space’ (Markusen 1996). Following in that tradition, Boschma and Frenken (2006) make the path dependency of firms in places a defining feature of EEG2 and the field remains predominantly concerned with economic evolution of places (Boschma and Martin 2010a). Extending the place-based perspective on development into environmental sustainability is a logical progression, and in this manifestation covers a spectrum from eco-localization’s emphasis on self-reliance as means to sustainability (Hudson 2007; North 2010; Bridge...
et al. 2013) to regions as systems for sustainability innovations and as exporters of such innovations (Cooke 2008).

A place-based approach to EEG2 is well underway. Recently, Essletzbichler’s (2012) rigorous analysis of renewable energy transitions, with especial reference to the UK, along with pleas by Bridge et al. (2013) and Coenen et al. (2012), have advanced this project by arguing for greater recognition of place, and concomitantly multi-scalar space, within the design of environmental (especially carbon-related) policies that are innately aspatial. Written from different but overlapping theoretical perspectives, these studies see the potential for purposeful sustainability transitions as a co-evolution of culture, science, economics, technology, politics and environment. Essletzbichler (2012)’s impressive analysis may be highlighted as it adds geographic scale to the multi-level perspective of the sustainability transition model, with its regimes, niches and landscapes, and comparatively and quantitatively assesses regional performance within national contexts.

Tilting at energy policy in the UK, Essletzbichler problematizes its path-dependent electricity generation regime depicting it as locked-in at the national scale. This meso-level regime consists of networks of actors such as utility companies, industrial users, consumers, and the governing ministry with vested interests in its perpetuation; formal, normative and cognitive rules including standards, pricing schemes, and so forth that favour incumbents and relatively little support for challengers; and the material and technical elements of vast investments in power plants, grids and so on. Unlocking this self-reinforcing regime, and particularly fostering local and regional renewables, requires opening up niches in the policy and industrial structure for firms to generate and adopt alternatives technologies. Changing landscape pressures (policy, cultural expectations, economic and resource scarcity conditions) can change the market and instil new competitive, that is Darwinian selective, pressures on firms and thereby compel a sustainable co-evolution. Using data on renewable energy patenting, Essletzbichler (2012) shows that regional performance in the UK lags behind Danish, German and Spanish experience that are shaped by stronger national policies that are more closely harmonized with regional specificities. A case study of the interdependence of actors, policy and structure in Navarra’s leading RE complex add weight to this argument. An important challenge facing the UK is the lack of stimulus to ‘green’ innovation at the regional level.

Table 1: Questions linking co-evolutionary and multi-scalar perspectives

(1) How will the co-evolutionary perspective inform the multi-scalar perspective? By analyses of:
- path dependence based responsiveness of different regions to adopt sustainable technologies and behaviours grounded in an understanding of firm routines and sector and regional institutions
- inverting the point above, the capacities of corporate and regional innovation systems to generate sustainability innovations
- transfers of technological and managerial information that affect environmental products and process, and regional and national complexes
- importance and complexity of technological innovation and adaptation. Scalar implication?
- the importance of competition within regions as they adapt and innovate
- failures to comply to treaties because of industrial capacity and versatility problems in different regional contexts
- implications of competition among places to develop environmental exports
- the implications of greening in one place and degradation in others
- the impact of policies in one place on another (e.g. subsidies, feed-in-tariff policies)

(2) How will the multi-scalar perspective inform co-evolutionary perspective? By the:
- integration of the lack of response and responses to environmental issues within the evolutionary economic perspective
- grounding of lifecycle analysis (LCA) and corporate environmental management (CEM) based mapping of material and energy transfers throughout the GVC/GNP
  - LCA and CEM spatialized and evolutionary bottlenecks identified by mapping flow of products, pollution, materials and energy through space and showing the governance impacts on its realization
- evaluation of carbon and other pollutant transfers and leakages through the GVC/GNP, and the impacts of one location’s actions on another
- recognition of the need for collective action and problem of free-riders at different (and among) scales
- identification of the need for policy co-ordination and harmonization and information exchange among scales
- identification of the role of politics, especially among jurisdictions, complimented by civil society and industry influences, with stakeholder engagement as necessity and requiring strategic responses
- mapping of impoverishment, security and livelihood issues resulting from failure to establish sustainable development
Coenen et al. (2012) and Bridge et al. (2013) offer more general pleas to convince that geography matters to sustainability policy. Thus, Coenen et al. (2012) take the multi-level perspective framework to task for not considering geographical scale, and particularly for disregarding how sustainability transitions are embedded in territorial institutions and how territories are connected across scales. Bridge et al. (2013) using the UK as context, add geographic attributes to the multi-scalar framework, emphasizing again the role of territorial embeddedness and path dependency within a multi-scalar framework and adding the importance of differentiation and scale. Of particular note, however, is their emphasis on absolute and relative location and landscape, that is, the importance of the actual physical environment, such as wind and solar resources and distance from markets. These, if not determinants of alternative energy potentials, are at least stronger shapers of them, and lend some nuance to the place versus path dependency debate.

Collectively these three studies reflect on dialectics between existing pathways and potentials for new ones and provide a strong base for further research (see Foxon 2011). In this regard, there is considerable scope to introduce more of the perspectives and empirical approaches of EEG2, RIS, cluster analysis, and the whole cornucopia of institutional concepts. This embrace might also be extended to some related approaches, notably several geographic interpretations of industrial ecology. Industrial symbiosis, for example, advocates highly localized co-location exchanges of energy and materials and services among companies, thereby transforming lost energy and waste into by-products and reducing environmental impacts (Chertow 1998; Ehrenfeld and Chertow 2002; van Leeuwen et al. 2003; Gibbs et al. 2005; Symbiosis Institute 2007; Deutz and Lyons 2008). Indeed, industrial symbiosis compliments EEG2 by its recognition of the need for mechanisms to enhance connectivity and to match quantitative and qualitative flows of materials and energy, thereby upgrading the environmental and economic performance, in localized settings. Thus industrial symbiosis has explored how institutions that provide infrastructural and institutional support, build trust and social capital, and overcome information asymmetry can evolve (Hewes and Lyons 2008). The need for competition and economies of scale and scope are problematized and direct some investigators to claim that industrial symbiosis requires scaling-up from the local to the regional level (Sterr and Ott 2004; Chertow et al. 2008; Deutz and Gibbs 2008; Ashton 2009). Further extension is required because, focused on industrial symbiosis, ironically geographic interpretations of industrial ecology have not dealt with the multi-scalar implications of the full product lifecycle or sustainable supply chains (Korhonen 2002; Seuring 2004).

The complexity of investigating multi-scalar relationships is daunting. The pioneering studies of Coenen et al. (2012), Essletzbichler (2012) and Bridge et al. (2013) refer to the role of transnational and global influence but focus their attention mainly at regional or national levels. Yet, not to take larger scale forces into account may lead to questionable positions. For example, with respect to the local and regional potential for carbon transitions, several geographers have already examined how carbon regulation processes at global and EU levels have impacted local and regional economies and societies (Bumpus and Liverman 2008; Baily and Maresh 2009; Boyd 2009; Ciscell 2010; Bailey et al. 2011; Bumpus 2011; Gutiérrez 2011; Knight 2011; Robertson 2012). Although some studies have aligned themselves with the bottom-up approach to mitigating climate change, the real impact of city or community efforts to transform their carbon footprint, beyond pilot programs and showpieces, is questionable (Bulkeley 2010). Consequently, geographers should not only consider the regional and national ramifications of global climate and other environmental agreements post hoc, but also engage in the debates on the graduated ascension into a climate reduction regime, harmonization of taxes and emission trading schemes, sector approaches, clubs and other mechanisms proffered to reform the UN-led top-down approach (Aldy and Stavins 2010; Barrett 2010; Frankel 2010; Sawa 2010; Victor 2011). Whether or not any of these suggestions will lead to an effective global agreement will influence whether regions or countries feel compelled to follow through with carbon transitions.

Moreover, along with global regulation, global competition determines the viability of place-based sustainability transitions, demonstrated evocatively by the turmoil that roiled the photovoltaic (PV) industry from 2011. PVs were a cornerstone of green development regional initiatives across Europe, North America, Japan and China. In a quid pro quo for eventual benefits, governments promoted, subsidized and regulated for PVs – subsidies paid for costs imposed on consumers through feed-in tariffs (e.g. Germany), renewable mandates (e.g.
force in a multi-scalar EEG. The rise of MNCs and oligopoly as a dominant global sector, but concentration has already occurred in the wind industry Japan took Ontario to the WTO for preferential treatment of Canadian suppliers. Indeed, Ontario’s attempt at green development, bringing in an MNE like Samsung to stimulate growth of local suppliers, demonstrates that green industries are not regional but global sectors. Thus the solar value chain is composed of polysilicon, wafers, cells, modules, essential materials, inverters and capital equipment, but although China (rather Jiangsu), because of its mass assembly volumes, overwhelmingly dominates trade in solar modules to the US, competitive advantages in producing high-value polysilicon and wafers and other material and capital equipment actually put the sector trading balance in the latter’s favour (Pew Charitable Trusts 2013). The PV turmoil, however, has delayed the steady march to oligopoly in the industry, but concentration has already occurred in the wind industry as the top 10 firms already control 78 per cent of the global market (Cleantech 2013). The PV turmoil, however, has delayed the steady march to oligopoly in the industry, but concentration has already occurred in the wind industry as the top 10 firms already control 78 per cent of the global market (Cleantech 2013). The rise of MNCs and oligopoly as a dominant global force in a multi-scalar EEG\(^2\) indicates a key role for value chains.

Global value chains and production networks

GVCs and GPNs have been significant themes in economic geography over the past two decades and are complementary insofar as they analyse production flows from suppliers through core firms to end users/consumers, and with the corollary of flows within different places and over space. They are implicitly multi-scalar in conception and are centrally concerned with the extent of embeddedness in linked geographies that feature clusters and dispersed operations. So far, however, GVCs and GPNs have not focused much on evolutionary dynamics (or connections to EEG\(^2\)) nor on environmental imperatives whether with respect to specific themes such as recycling or more general concerns for negative externalities. If there is a 100 dollar bill lying on the ground waiting for EEG\(^2\) to pick it up, then it is turning a focus on the environmental performance GVC/GPNs, and their principal organizing agents, MNCs. MNCs exert enormous leverage on the world economy and their environmental performance is fashioned by the different territorial complexes in which they operate.

The impacts that MNCs impose on home and host countries are huge (Caves 1996; Dunning and Lundan 2008; Dicken 2011). According to UNCTAD (2011), MNCs generated a quarter of global value-added GDP or about US$ 16 trillion in 2010 while supply chain, franchising, licensing and other types of non-equity modes of production generated at least another US$ 2 trillion of value added. As an example of home country impacts, McKinsey (Cummings \textit{et al.} 2010) estimates that US-based MNCs are directly responsible for 23 per cent of private sector GDP, that since 1990 they have delivered 34 per cent of US growth, half of its exports and a third of imports, directly employ 19 per cent of US private sector labour and 28 per cent through multiplier effects. In host countries, FDI is responsible for 20 per cent of global fixed investment, and MNC affiliates generate sales that are twice the value of MNC-based trade (McCann 2009). MNCs have impelled growth in trade at rates double that of global GDP over several decades, much through internal transfers. As a sobering counterpoint to eco-localization aspirations (especially those constructed through innovation) it is instructive to note that MNCs dominate private sector R\&D that in turn has significant productivity impacts. Indeed, globally MNCs accounted for about 46 per cent of all global R\&D expenditure in 2005 and 69 per cent of private sector R\&D spending (McCann 2009). How the generation, diffusion and adaptation of innovations play out through global value chains and on the territorial basis of global production networks is largely un-investigated, including with respect to green technologies and systems.

Within the GVC and GNP (and related) literatures MNCs are the principal organizing agents. As modelled by Gereffi \textit{et al.} (2005) GVCs examine vertical relations among firms as they extend from region to region and across borders. This model provides five configurations of intra-sector or intra-firm relations and three mechanisms governing exchange: complexity of information and facility for exchange; the codability of knowledge; and capabilities inherent to the supply base. Roughly with the mapping and analysis of these vertical relations, the influence of global environmental governance...
on location, operational, investment and innovation practices of firms has been recognized (Angel *et al.* 2007; Press 2010). This model could be extended to measure how energy, materials, environmental management and innovations flow through the value chain. Transaction costs analysis is particularly amenable to those latter tasks (Patchell 1996).

The GPN is similarly concerned with vertical coordination of the value chain, but draws attention to how local or regional networks, including civil society organizations, states (and other levels of government), firms, labour and consumers influence production at different stages within the value chain (Coe *et al.* 2008; Coe 2011). Several researchers have elaborated this perspective (Liu and Dicken 2006; Kelly 2009; Lund-Thomsen and Nadvi 2010; Murphy and Schindler 2011). Although neither GVC nor GPN models are discussed in EEG2’s key themes of path dependency and innovation, both incorporate territorial segmentation of the value chain and thus are amenable to integrating the dynamics examined in EEG2’s regional focus. Drawing the territorial locus into the discussion would enable more constructive unpacking of why, in a globally interdependent – MNC and value chain – process, bottlenecks to environmental innovations and adaptations occur or conversely innovations can be captured for global diffusion. Moreover, tracing territorial responses through the GVC can shed light on the realities and relativities of pollution enclaves and exports, carbon leakage, shifting environmental Kuznets curves, green development policies, consequences of policy harmonies and disharmonies and the like.

The GVC/GNP contribution to explicating the multi-scalar co-evolution of sustainability technologies and territorial adaptations would be advanced by the incorporation of lifecycle concepts. Indeed most MNCs are actively engaged in how their products should be designed, produced, distributed, and recovered for recycling (Fig. 2). In each stage of the lifecycle, there is a need to reduce the emissions of waste materials, energy and toxins in the processes and embodied in the product that is passed on upstream. Recovery and recycling transform an industrial process that followed a linear path from extraction to waste disposal into a cycle of materials and energy. This depiction is relevant for end-product firms; firms that supply the materials, components, and services that make up the lifecycle of the product; and to service industry firms that incorporate other goods and services in their own

![Figure 2. Value chains and the environment. Source: authors.](image-url)
product and are responsible for the environmental impacts incurred by their demand.

Commitments to such lifecycle processes can be found in the environmental reports of large companies, complete with design, production and environmental impact information. The conceptual model derives from a large literature on design for environment (McDonough and Braungart 2002; Fiksel 2009). The regulatory requirement to design and steward the lifecycle in this manner is found in a diversity of extended producer responsibility and kindred laws such as the following: in the EU, the Waste in Electric and Electronic Equipment (WEEE) and Regulation on Hazardous Substances (RoHS); in Japan similar recycling EPR laws across the home appliance, automobile, and computer sectors and the Top Runner Program for energy conservation; and in the US, Energy Star for electric appliances, Leadership in Energy Efficiency Design (LEED) standards for buildings, the Corporate Average Fuel Economy (CAFE) for automobiles. The regulations are supported by a long list of private government and third party systems for lifecycle analysis used for product design or for corporate reporting (e.g. the Global Reporting Initiative, ISO 14006 and ecological footprints), and several specifically designed for carbon footprint analysis and reporting (e.g. GHG Reporting Protocol, PAS 2050, ISO 14064 and 14065, and the Carbon Disclosure Project). Moreover, a large literature on sustainable (or green) supply chains, distribution channels, and reverse logistics, operations management and related topics (Srivastava 2007; Seuring and Müller 2008) examines how relations upstream and downstream are practiced and could be improved. However, this literature does not directly discuss spatial and territorial influences. The task for EEG² would be to extend the lifecycle model used by corporations to incorporate territorial environmental governance processes to transform the GVC/GNP into a global value cycle.

How EEG² works in a GVC/GNP framework can be exemplified briefly by a Japanese example. In the 1990s Japan developed an EPR system to govern the production, distribution and recycling of home appliances (home appliance recycling law covering TVs, refrigerators, washing machines and air conditioners). Government and industry stakeholders discussed the regulations for home appliances (Tasaki et al. 2005; DTI 2006) and devised a system particular to the Japanese context. In Europe, consortiums take care of recycling, but Japan made an individual producer responsibility system in which major brand manufacturers are directly responsible for the recovery and recycling of their products. Two groups, led by Hitachi and Panasonic respectively, set up nationwide systems of depots for collection and recycling plants. Importantly, these manufacturers set up recycling plants as laboratories to learn how their products could be designed to be more recyclable, physically and economically. While achieving that goal for each manufacturer, the system also spreads the costs of nationwide collection and recovery among the different manufacturers. The Japanese government and manufacturers were confident in establishing this system because over 80% of the products are made in Japan, the manufacturing base is deep and diverse enough to both innovate in environmental design and recovery technologies, and because government and industry collaborated on the system (e.g. each manufacturer was supported in developing its recycling centre). Another particular feature is that consumers pay the cost of recycling at the end of use and distributors must take back the product for transfer to the recovery system. The end of use payment has been critiqued as untenable in other contexts (Lindhqvist and Lifset 2003).

While in Japan, there are high conversion rates of recovered appliances to recycled material (>80%), Japanese MNCs have had limited success duplicating this performance in other regulatory systems. The EU, with its own EPR laws, would seem a fertile ground for extension of Japanese practices, but each country is allowed to establish its own system, resulting in a failure of transposition of the EU directive and throughout the region third parties perform recycling. The US with its greater capacity for land filling has less incentive to develop recycling systems or compel recycling at either a federal or state level. Only a few states have begun to implement EPR systems and most rely more on market forces to foster the development of recycling companies and the integration between recovery and recycling activities. In China, Japanese firms are advising on recycling regulations, but implementation will wait until the authorities deem Chinese firms capable of fulfilling them. In general, a critical feature of successful programmes is feedback from manufacturers’ recycling operations to design appliances to make them more recyclable, along with competitive incentives to ensure continual improvement in industry. However, the co-evolution of the components of corporate recycling (Fig. 2) is powerfully
shaped by the values, capabilities and regulations of places, and how different systems integrate, hybridize or differentiate across space is worthy of more study.

**EEG$^2$ and core–resource periphery co-evolution**

Investigations into GVCs and GPNs have often recognized cores, peripheries and semi-peripheries even as they emphasize the criss-crossing of spatial scales. Yet, these spatial chains and networks have largely focused on secondary manufacturing activities in which key functions are dispersed, with that relocation resulting in new economic spaces that may in turn stimulate various types of new clusters. With illuminating exceptions, highlighted by Bridge (2008b), resource-based chains and their environmental impacts have not been part of GVC/GPN analyses. But the globalization of industrialization has greatly escalated demands and geographically diversified resource-based value chains. Moreover, resources not only create their “own” globalized structures but are present in every type of value chain or network. Critically that resource exploitation is at the heart of climate change, biodiversity and degradation problems that are multi-scalar in nature because the greatest ecological footprint from industrial and consumption practices lands rudely in the periphery. Indeed urban demands have exerted massive impacts on path dependencies and massive environmental damage in resource peripheries and changing core–periphery dynamics need to be a research priority for EEG$^2$ that can be readily appreciated within GVC/GNP frameworks.

Within economic geography, the complementarities and contradictions of core–periphery relations have long been recognized. Intimately tied together by trade and related connections and often institutionalized within MNCs, peripheries provide the food and resources needed by cores while the latter provide the markets, and often the technology, goods and services, even labour supplies, required by peripheries. Simultaneously, cores and peripheries compete with one another over price, the rate of exploitation and the location of value added. In this regard, diverse sources of supply, the development of substitute products, market access and the concentration of control functions has given cores the balance of bargaining power, and globally the bargaining advantages of core countries can be reinforced by the resource endowments of domestic peripheries. The ability of peripheries to exploit their resources to secure more diversified self-sustaining economies has varied; some becoming rich and post-industrial (Walker 2001) while some are cursed (Auty 2001).

Significantly, vital to the mandate of EEG$^2$, environmental imperatives are redefining the contradictions and complementarities between cores and resource peripheries. Even as resource exports increase, and expand to even more remote locations, there is growing concern for their ecological footprints. Thus, consistent trends towards recycling, dematerialization, internalization of negative externalities, environmental certification, greater appreciation for the cultural and aesthetic values of nature, and growing concern over the links between poverty and environmental sustainability in poor peripheries are exerting profound effects within peripheries, and their global roles. Indeed, the economic and environmental geography of resources simply cannot be divorced. For example, as one important environmentally driven feature of globalization, scarcely noted within economic geography, there has been massive expansions of protected (conservation) areas around the world, in terms of nationally designated territories from 2 to 14 million km$^2$ between 1965 and 2006, with a further 3.8 million km$^2$ of sea protected, from virtually nothing in 1973 (Zimmerer 2006). This ongoing “remapping” or “re-territorialization” towards the privileging of environmental values has almost entirely occurred in the world’s peripheries, and has reduced, even eliminated possibilities for resource-based commodification (Affolderbach et al. 2012). However, environmental imperatives are contributing to the competitive advantages of resource peripheries that provide renewable sources of energy in the form of solar, wind, water and biotic sources of power, while enlarging ecotourism potentials and smaller scale exploitation.

The proliferation of resource conflicts around the world, especially but not limited to non-renewable fossil fuels and minerals, are a vital indicator of why core–periphery relationships (“geography”) matter, and further underline the case for EEG$^2$. These conflicts are so intense because they are driven by such a diversity of institutional agencies that involve powerful vested interests and path dependencies, geopolitical considerations, economic development imperatives along with new voices that seek to emphasize the non-industrial values of resources (Hayter et al. 2003; Barton et al. 2008). The Athabasca oil/tar sands, centred at Fort McMurray,
Alberta, illustrates the complexity of these clashes. This project is in the global eye of an economy versus environment sustainability storm that now only centres on the production facilities themselves but also new and enlarged pipeline proposals to increase flows south to the US, west (or maybe north via the Arctic) to tap into Chinese demands, and east to central Canadian markets as part of a mooted national energy strategy. As a high cost, remote region exploitation of the Athabasca oil sands depended on technological developments to allow extraction of “heavy” oil, the exhaustion of low-cost more accessible light oil and higher oil prices. Its economic impacts are huge, in Alberta the basis of significant revenues to the provincial government, for the boom (oil extraction) town of Fort McMurray, large clusters of (legal, engineering, financial and other) service-supporting activities in Calgary and manufacturing support activities in Edmonton. The project has provided tens of thousands of extremely high-income jobs to migrant workers from resource towns in decline across Canada, manufacturing spin-off jobs in Ontario and Quebec, while Alberta’s oil wealth has made the province a major contributor to “equalization grants” (CA$ 14.2 billion in 2009–2010) that are provided to “have not” provinces in Canada to help them pay for education, social and health services. Exports to China would serve to reduce dependence on US markets (and their discounted prices), and the proposed pipelines would generate substantial construction activity. Yet, Athabasca oil is perceived as “dirty oil”, its operations leading to local and regional soil and water degradation and global climate change, and the pipeline projects in British Columbia and the US are vehemently opposed by environmental and (some Aboriginal) groups for fears over oil spills from pipelines and oil tankers.

The Athabasca oil/tar sands poses fascinating research problems for EEG. Does it make sense, for example, to shut down this project that has already incurred massive sunk costs only to sink further infrastructure in other regions, for example, Alaska, the Falkland Islands or the Polar regions? How will such sunk costs be stranded as energy technologies become more varied and relative price changes rapidly shift locations of production as fracking of shale oil and gas have done to coal? Would not exploitation of the largely untouched Polar regions, partly facilitated by the cumulative impacts of climate warming, more than offset the size of the new geographies of conservation? More generally, the debates that rage over how best to use (or not use) resources in peripheral areas around the globe raise questions about the effectiveness of confrontation and conflict as a means to achieve a greener future. Environmental conflict may be necessary to unlock locked-in attitudes and infrastructures. But bargains made in conflict may not be optimal, and the regional development and ecological economics literatures argue that cooperative behaviour leads to the best outcomes (Patchell 1996; Storper 1997). How conflict resolution and cooperative behaviour in support of a green paradigm can be achieved is an interesting policy issue for EEG. A related question is how innovation in support of the green paradigm or sustainability transition can be directed towards ensuring positive sum games between economy, environment and equity perspectives. And how should the distribution of R&D systems between public and private sector agencies and cores and peripheries be modified to achieve these goals?

**Conclusion: can geography tackle the “everywhere” of environmental issues?**

This article has “used” EEG, not as a new turn, but as a passing convenience or device to encourage an integration of related approaches in economic geography, as represented by EEG1 and 2. This plea recognizes that integrating economy and environment is a central co-evolutionary challenge of the 21st century. That is, although economy and environment have been treated as distinctive issues they are nevertheless interdependent within places and among scales. Geographers have key roles to play in understanding these interdependencies in support of sustainable development.

As our guide to this integration, the reasoned history approach to economic development shows the historical interaction of economics, society, politics and technology, summarized as TEPs (Freeman and Louça 2001), that contextualizes frameworks designed to analyze contemporary sustainability transitions (Foxon 2011; Coenen et al. 2012). During the first four TEPs, development created great wealth and self-propelling growth among relatively few leading nations that controlled the innovative processes, but failing to integrate environmental costs, incurred massive global problems of inequality and environmental degradation. The fifth TEP has seen industrialization and wealth generation (and innovation potentials) not only embrace more countries but also become globally connected at an unprecedented
scale and complexity. Yet, poverty and environmental problems remain acute. It has become axiomatic that technological and institutional innovations to improve the environment must be pervasively integrated into development to generate a future green paradigm or sustainability transition.

Enter geography, as the discipline oriented to exploring how and why this integration is or is not occurring over space, the seedbeds and bottlenecks in a global network of interdependent sustainability transformations. Many issues involved in these transformations will only be resolved if they are “tackled everywhere”, taking into account context, scale and legacies. Our article argues that case and draws together different strands of economic geography that make a multi-scale co-evolutionary approach possible. In our view EEG1 and 2 can benefit greatly from closer ties, a challenge facilitated by their joint roots in institutional approaches to economic geography and the social sciences more generally. For economic geography, a relatively small sub-discipline, it also makes practical sense, both in educational and policy terms, to integrate research efforts rather than fragment them. The multi-scale approach provides a framework to incorporate what have arisen as disparate concepts and methodologies to address the spatial interdependence of environmental issues in a robust manner.

Acknowledgments

The authors are grateful to comments from three referees, Dieter Soyez and the perceptive advice and encouragement of the editor.

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